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THE LASTING EFFICIENCY OF FLOORING NAILS

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From left to right: Plain-shank flooring brad, helically threaded *Screw-tite* flooring nail, and front and side views of light (New York Pattern) cut flooring nail. Twice actual size.

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Simulating the long-time effect during accelerated exposure tests on the efficiency of three standard types of flooring nails, the helically threaded *Screw-tite* nail proved to have as much as a 6.7 times greater holding power than the same-size plain-shank flooring brad and a 4 times greater holding power than the light cut nail.

The efficiency of flooring nails ultimately depends on the services rendered by the nails during the lifetime of a flooring installation. Long-time observations of flooring segments which are fastened by means of various types of available nails are time consuming. Such observations, however, can be made within a relatively short time by means of accelerated service tests during which the moisture content of the wood to which the flooring is nailed undergoes relatively drastic changes. The exposure conditions employed are to result in such deterioration in the holding power of the nails as may occur in service during the lifetime of the flooring.

Such accelerated service tests, ranging over a one-year period, were performed in the Wood Research Laboratory of the Virginia Polytechnic Institute, under the sponsorship of the Independent Nail & Packing Company of Bridgewater, Massachusetts, the manufacturer of the helically threaded *Screw-tite* nails. Thus, fully comparative tests were performed with (1) 2½-in. long plain-shank flooring brads manufactured from low-carbon-steel wire of 0.113-in. diameter with blunt Diamond points and countersunk heads; (2) 2½-in. long light (New York Pattern) cut flooring nails, which actually are casing nails, manufactured from 0.110-in. thick low-carbon-steel sheet with a maximum width under the head of 0.220 in. and a minimum width at the point of 0.080 inch; and (3) 2½-in. long hardened helically threaded *Screw-tite* flooring nails manufactured from high-carbon-steel wire of 0.113-in. diameter with blunt Diamond points, countersunk heads, and ⅞-in. clearances between nail heads and rolled-on threads. These latter nails were provided with a 60-deg. thread slope and a 0.090-in. center-to-center thread spacing. Samples of the above nails are shown in the Frontispiece.

For testing these nails, clear air-dried planed 3 by 8-in. southern pine was used having an oven-dry specific gravity of 0.50-0.56 and a moisture content of 16 percent during nail driving to ⅔ shank penetration. The quintuplicate test locations were spaced perpendicular to grain and 1¼-in. apart. The spacing of the different types of nails

and of the groups of nails to be tested at given periods was parallel with the grain and 1½-in. apart. An Olsen universal testing machine with a 1400-lb. capacity poise and a constant cross-head motion of 0.060 in. per min. was provided with special devices for the performance of the axial withdrawal tests.

Tests were performed (1) immediately after driving at 16 percent moisture content, (2) after one-week water-soaking and one-day subsequent air-drying to 38 percent moisture content, (3) after one-week soaking and one-week subsequent drying to 23 percent moisture content, (4) after one-week soaking and four-week subsequent drying to 15 percent moisture content, (5) after one-week soaking, four-week subsequent drying, one-week subsequent soaking, and one-day subsequent drying to 35 percent moisture content, (6) after one-week soaking, four-week subsequent drying, one-week subsequent soaking, and one-week subsequent drying to 24 percent moisture content, (7) after one-week soaking, four-week subsequent drying, one-week subsequent soaking, and four-week subsequent drying to 16 percent moisture content, (8) after one-week soaking, four-week subsequent drying, one-week subsequent soaking, four-week subsequent drying, one-week subsequent soaking, and one-day subsequent drying to 36 percent moisture content, (9) as before, however, after one-week subsequent final drying to 22 percent moisture content, (10) as before, however, after four-week subsequent final drying to 15 percent moisture content, (11) as before, however, after fifteen-week subsequent final drying to 11 percent moisture content, and (12) as before, however, after 41-week subsequent final drying to 10 percent moisture content, that is 52 weeks after nail driving.

The detailed test data are presented in the Appendix.

A comparison of the average values for the quintuplicate test data on the axial withdrawal resistance of the investigated flooring nails is made in Table I and graphically illustrated in Fig. 1.

Throughout the test performance during the one-year test period, the efficiency of the helically threaded *Screw-tite* nails was considerably greater, that is, from 53 to 570 percent greater than that of the plain-shank brads and from 15 to 301 percent greater than that of the cut nails.

The initial holding power of the *Screw-tite* nails was 283 percent greater than that of the plain-shank brads and 38 percent greater than that of the cut nails. On the other hand, after one-year exposure, the holding power of the *Screw-tite* nails was 570 percent greater than that of the plain-shank brads and 301 percent greater than that of the cut nails.

While, during the total test period, the holding power of the plain-shank brads decreased 3 percent and that of the cut nails decreased 42 percent, the holding power of the *Screw-tite* nails increased 70 percent, although the initial holding power of the *Screw-tite* nails was considerably greater than that of the other two nails.

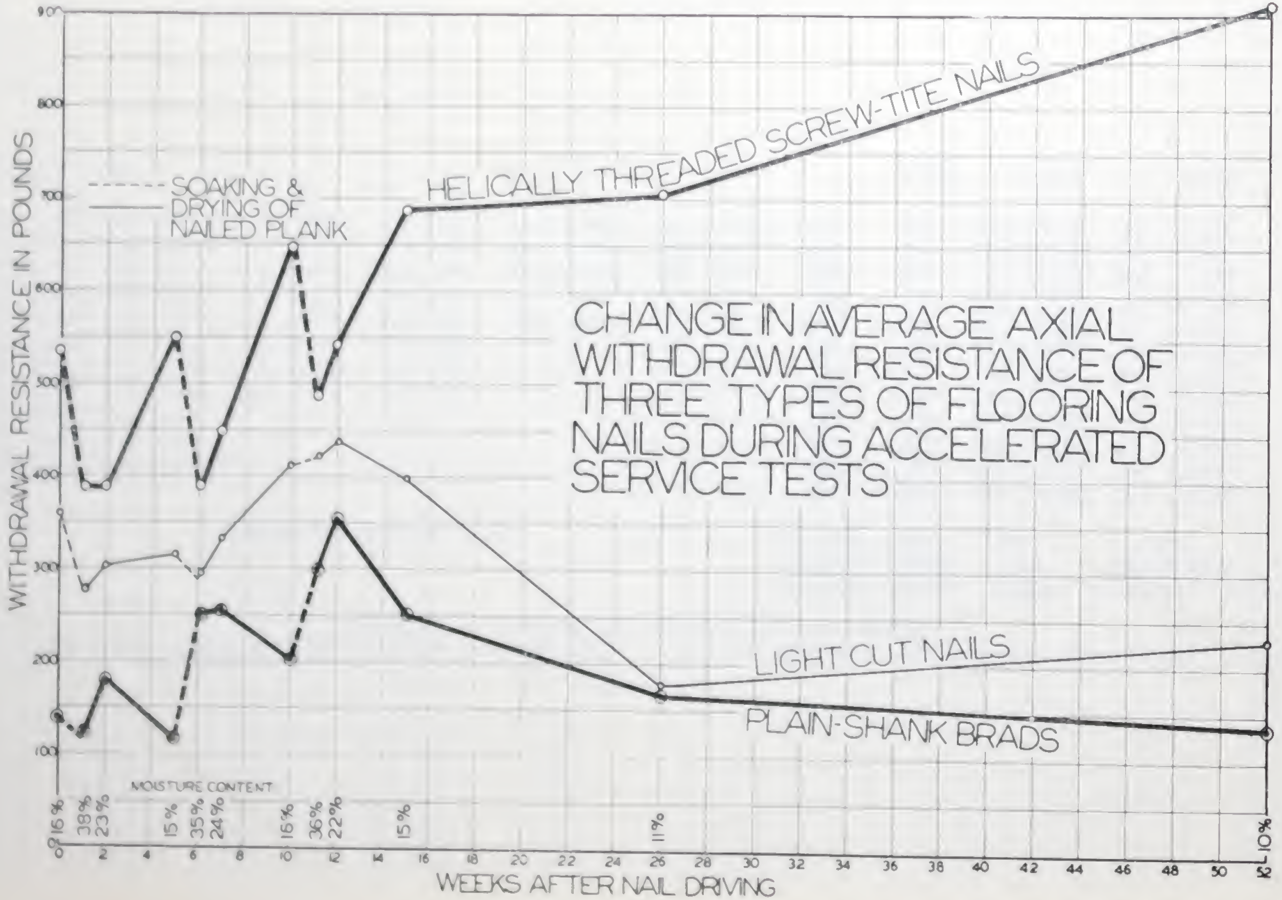
During the three periods of one-week water-soaking and subsequent one-day air-drying, the holding power of plain-shank brads decreased 11 percent and increased 113 and 48 percent, respectively; that of

Table I

Average Axial Withdrawal Resistance of Flooring Nails Driven into Southern Pine Plank of 16% Moisture Content According to Matched Quintuplicate Tests In Pounds

Tested After Given Delay	Moisture Content At Test	Plain-Shank Brad	Light Cut Nail	Helically Threaded Screw-tite Nail
None	16%	140	389 (278%)	536 (383%)
1-W. Soak., 1-D. Dry.	38%	125	278 (222%)	386 (309%)
1-W. Soak., 1-W. Dry.	23%	180	303 (168%)	387 (215%)
1-W. Soak., 4-W. Dry.	15%	118	316 (268%)	550 (466%)
1-W. Soak., 4-W. Dry., 1-W. Soak., 1-D. Dry.	35%	251	295 (118%)	388 (155%)
1-W. Soak., 4-W. Dry., 1-W. Soak., 1-W. Dry.	24%	256	333 (130%)	447 (175%)
1-W. Soak., 4-W. Dry., 1-W. Soak., 4-W. Dry.	16%	203	413 (203%)	647 (319%)
1-W. Soak., 4-W. Dry., 1-W. Soak., 4-W. Dry., 1-W. Soak., 1-D. Dry.	36%	300	421 (140%)	486 (162%)
1-W. Soak., 4-W. Dry., 1-W. Soak., 4-W. Dry., 1-W. Soak., 1-W. Dry.	22%	354	439 (124%)	543 (153%)
1-W. Soak., 4-W. Dry., 1-W. Soak., 4-W. Dry., 1-W. Soak., 4-W. Dry.	15%	251	398 (159%)	689 (275%)
1-W. Soak., 4-W. Dry., 1-W. Soak., 4-W. Dry., 1-W. Soak., 15-W. Dry.	11%	167	178 (107%)	706 (423%)
1-W. Soak., 4-W. Dry., 1-W. Soak., 4-W. Dry., 1-W. Soak., 41-W. Dry.	10%	136	227 (167%)	911 (670%)
Grand Average		(100%)	(174%)	(309%)

Figure 1



CHANGE IN AVERAGE AXIAL WITHDRAWAL RESISTANCE OF THREE TYPES OF FLOORING NAILS DURING ACCELERATED SERVICE TESTS
SOAKING & DRYING OF NAILED PLANK
HELICALLY THREADED SCREW-TITE NAILS
LIGHT CUT NAILS
PLAIN-SHANK BRADS
WITHDRAWAL RESISTANCE IN POUNDS
WEEKS AFTER NAIL DRIVING
MOISTURE CONTENT
16%
38%
23%
15%
35%
24%
16%
36%
22%
15%
11%
10%

the cut nails decreased 29 and 7 percent and increased 2 percent, respectively; and that of the *Screw-tite* nails decreased 28, 29, and 25 percent, respectively. On the other hand, during the three subsequent four-week drying periods, the holding power of the plain-shank brads decreased 6, 19, and 16 percent, respectively; that of the cut nails increased 14 and 40 percent and decreased 5 percent, respectively; and that of the *Screw-tite* nails increased 42, 67, and 42 percent, respectively.

The last-described decreases in holding power after the last soaking period continued to decrease 33 percent for plain-shank brads and 55 percent for cut nails during the subsequent 11-week air-drying and 46 percent for plain-shank brads and 43 percent for cut nails during the subsequent 37-week air-drying. On the other hand, the last-described increases in holding power for the *Screw-tite* nails after the last soaking period continued to increase 2 percent during the subsequent 11-week air-drying and 32 percent during the subsequent 37-week air-drying.

As a result of these considerable increases in holding power of *Screw-tite* nails during the drying periods subsequent to the soaking periods, the temporary decreases in their holding power during the soaking periods were more than compensated.

While, in comparison with the efficiency of the plain-shank brads, the tested cut nails offered a 2.8 times greater efficiency immediately after driving and only a 1.7 times greater efficiency after one-year exposure, the helically threaded *Screw-tite* nails provided a 3.8 times greater immediate holding power and a 6.7 times greater holding power after the one-year period of accelerated service tests. Hence, the efficiency of the *Screw-tite* nails amounted to 4.0 times that of the cut nails after one-year exposure.

Thus, in agreement with previously published findings * and field experience, the helically threaded *Screw-tite* flooring nails proved to be far superior in immediate and delayed holding power to plain-shank flooring brads and cut flooring nails. Furthermore, considering that (1) the lighter *Screw-tite* nails cost almost 30 percent less than cut nails; (2) can be driven with less effort; (3) reduce the possibility of splitting the flooring during nailing; (4) assure tighter fastening of the flooring partly because of the clearance between nail head and threads and, thus, (5) eliminate loose, squeaky, springy or buckled flooring under normal service conditions, the most general use of helically threaded *Screw-tite* flooring nails appears to be opportune from every viewpoint.

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* 1) "Three Standard Types of Flooring Nails," V. P. I. Wood Research Laboratory Release No. 49100501, October, 1949, published by Independent Nail & Packing Company of Bridgewater, Massachusetts.

2) "Special Flooring Nails Show Greater Holding Power in V. P. I. Tests," Flooring, Vol. 37, No. 4, November, 1949, pp. 13-14.

3) "Flooring Nails in Green and Dry Lumber," Flooring, Vol. 37, No. 9, April, 1951, pp. 14 and 20.

4) "Efficiency of Flooring Nails," Virginia Polytechnic Institute Engineering Experiment Station Bulletin No. 78, May, 1951.

APPENDIX—Detailed Test Data

Comparative Axial Withdrawal Resistance, in Pounds, of Three Standard Types of 8-d Flooring Nails Simultaneously Driven to Two-Third Shank Penetration into Air-Dry Southern Pine Tested Immediately After Driving or After Subsequent Cycles of Water-Soaking and Air-Drying.

Test Performance	Test Sign	Plain-Shank Flooring Brad	Cut Flooring Nail	Helically Threaded Screwtite Flooring Nail
Immediately	a	129	374	510
After	b	132	363	557
Driving	c	144	400	509
At 16.1%	d	139	421	567
M. C.	e	154	389	537
	Avg.	140 (100%)	389 (278%)	536 (383%)
After 1-Week	a	101	257	367
Soaking and	b	125	262	385
1-Day Drying	c	133	314	379
At 38.2%	d	141	296	397
M. C.	e	125	263	404
	Avg.	125 (100%)	278 (222%)	386 (309%)
After 1-Week	a	189	312	390
Soaking and	b	---	---	---
1-Week Drying	c	201	331	393
At 23.1%	d	157	311	379
M. C.	e	174	280	386
	Avg.	180 (100%)	303 (168%)	387 (215%)
After 1-week	a	95	300	541
Soaking and	b	---	---	---
4-week Drying	c	121	293	565
At 15.4%	d	131	343	523
M. C.	e	124	331	570
	Avg.	118 (100%)	316 (268%)	550 (466%)
After 1-W. Soak.,	a	280	284	303
4-W. Dry.,	b	---	---	---
1-W. Soak.,	c	263	317	384
1-D. Dry.	d	210	278	415
At 35.3%	e	252	301	451
M. C.	Avg.	251 (100%)	295 (118%)	388 (155%)
After 1-W. Soak.,	a	228	350	451
4-W. Dry.,	b	---	---	---
1-W. Soak.,	c	263	336	470
1-W. Dry.	d	284	313	447
At 24.0%	e	247	333	421
M. C.	Avg.	256 (100%)	333 (130%)	447 (175%)
After 1-W. Soak.,	a	187	378	618
4-W. Dry.,	b	203	397	632
1-W. Soak.,	c	221	442	661
4-W. Dry.	d	193	404	643
At 16.4%	e	209	443	679
M. C.	Avg.	203 (100%)	413 (203%)	647 (319%)
After 1-W. Soak.,	a	274	401	465
4-W. Dry.,	b	293	433	478
1-W. Soak.,	c	311	455	513
4-W. Dry.,	d	307	419	474
1-W. Soak.,	e	317	396	498
At 35.9% MC.1-D. Dry.	Avg.	300 (100%)	421 (140%)	486 (162%)
After 1-W. Soak.,	a	315	445	524
4-W. Dry.,	b	343	432	528
1-W. Soak.,	c	367	480	553
4-W. Dry.,	d	381	397	558
1-W. Soak.,	e	366	439	553
At 21.8% MC 1-W. Dry.	Avg.	354 (100%)	439 (124%)	543 (153%)
After 1-W. Soak.,	a	269	401	645
4-W. Dry.,	b	224	388	667
1-W. Soak.,	c	256	431	693
4-W. Dry.,	d	227	394	727
1-W. Soak.,	e	280	374	713
At 15.3% MC 4-W. Dry.	Avg.	251 (100%)	398 (159%)	689 (275%)
After 1-W. Soak.,	a	143	168	681
4-W. Dry.,	b	191	152	702
1-W. Soak.,	c	177	181	732
4-W. Dry.,	d	174	203	693
1-W. Soak.,	e	149	184	720
At 11.4% MC 15-W. Dry.	Avg.	167 (100%)	178 (107%)	706 (423%)
After 1-W. Soak.,	a	132	187	955
4-W. Dry.,	b	114	240	899
1-W. Soak.,	c	126	228	883
4-W. Dry.,	d	147	211	903
1-W. Soak.,	e	162	267	916
At 10.1% MC 41-W. Dry.	Avg.	136 (100%)	227 (167%)	911 (670%)